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Uskert et al.

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(54) **METHOD OF MANUFACTURING A TURBOMACHINE COMPONENT, AN AIRFOIL AND A GAS TURBINE ENGINE**

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(56) **References Cited**

U.S. PATENT DOCUMENTS

2,648,520 A * 8/1953 Schmitt F01D 5/187
29/889.721
3,825,364 A * 7/1974 Halila F01D 11/12
165/907

(Continued)

FOREIGN PATENT DOCUMENTS

EP 1 593 757 A1 11/2005

OTHER PUBLICATIONS

International Search Report and Written Opinion, PCT/US2012/072228, dated Sep. 5, 2013.

(Continued)

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(57) **ABSTRACT**

One embodiment of the present invention is a unique method of manufacturing a component for a turbomachine, such as an airfoil. Another embodiment is a unique airfoil. Yet another embodiment is a unique gas turbine engine. Other embodiments include apparatuses, systems, devices, hardware, methods, and combinations for cooled gas turbine engine components. Further embodiments, forms, features, aspects, benefits, and advantages of the present application will become apparent from the description and figures provided herewith.

24 Claims, 4 Drawing Sheets

